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ABSTRACT

One purpose of this study was to design a set of procedures for interviewing pupils in order to diagnose mathematical difficulties. A second purpose was to evaluate a manual describing these procedures to preservice elementary teachers, and to determine the relationship of their abilities to use these procedures with scores on mathematics concept and computation tests. Pilot testing was performed in order to determine reliabilities of the six measures used. Procedures for selection of interviewees, taping of interviews, etc. were established. Preservice teachers (116) attending four colleges formed the experimental group. Results indicated that the mean score on the computation test was 80 percent, with similar results on the mathematics concept test. Eighty percent of subjects successfully followed the manual as well; however, correlational analysis showed that this ability was different from the ability to elicit student reasoning. Less than half of all subjects were able to identify students' computational strategies or thought processes. The ability to make this identification was unrelated to the other variables tested. (SD)

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PRE-SERVICE TEACHERS' ANALYSES OF VERBAL AND WRITTEN
RESPONSES BY PUPILS TO SELECTED ADDITION EXAMPLES

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Instructional programs which provide individualized diagnostic and prescriptive mathematics instruction have become increasingly popular. One of the problems most often cited by mathematics educators is the lack of classroom teachers' ability to determine sources of pupils' errors and the nature of their thought processes. Teachers need this ability to prescribe correctives and practice materials.

Significance and Purpose

Many mathematics methods texts suggest that teachers examine pupils' errors made on traditional pencil and paper tests in order to prescribe correctives and appropriate practice materials. From the point of view of this research study, such test performance and related teacher examination by themselves are not sufficient for detecting the reasons for pupils' errors.

Recent studies indicate that a personal interview while pupils perform computation tasks more explicitly reveals reasons for pupils' errors and helps the teacher identify pupils' thought processes. Hence an interview technique may provide the information needed for classroom teachers to prescribe appropriate correctives and practice materials.

Therefore, the purpose of this study was to:

- (1) design an instructional manual and procedures to be used by pre-service teachers during an in-school interview of an elementary school pupil;
- (2) assess the ability of pre-service elementary teachers to interview pupils during arithmetic computation to identify their computational strategies, mathematical principles, and thought processes;
- (3) determine the intercorrelations that exist between:
 - (a) the pre-service teachers' scores on a mathematics concept test,
 - (b) their scores on a computation test,
 - (c) their ability to follow a set of interviewing instructions,

(d) their ability to elicit reasoning underlying pupils' responses,

(e) their ability to identify elicited computational strategies, mathematical principles and thought processes,

(f) the composite of (c), (d), (e);

(4) gather baseline data that could be used to evaluate and develop a training program which would prepare elementary teachers more effectively to prescribe correctives and practice materials for computation skills, algorismic understanding, and ease of performance.

Procedures

The population consisted of 116 pre-service elementary teachers whose teaching assignments were in urban and suburban schools. The pre-service teachers were in attendance in the Fall of 1973 or in the Spring of 1974 at one of four colleges: Baruch College, City University of New York, New York; The Pennsylvania State University at University Park, Pennsylvania; Kean College of New Jersey, Union, New Jersey; and Trenton State College, Trenton, New Jersey.

Procedures for conducting the interview were pre-tested during the Spring of 1973 in order to establish the standard to be used during the study. Tests of arithmetic computation and concept knowledge, administered to the teacher subjects, were designed and pilot-tested on comparable groups of students during the Summer Session of 1973. These tests yielded Kuder-Richardson Formula 20 reliability coefficients of .89 and .84, respectively. An analysis form was also designed for use by the teacher subjects following the interview of the pupil.

Procedures were also established for the choice of the pupil interviewees. Each was to be an elementary school student of 8 to 10 years and to have been chosen without regard to computational ability. Materials were assembled for tape recording the interviews. Rating scales were designed to evaluate the abilities

described in (3) (c), (d), (e), (f) on the preceding pages. Raters held several practice sessions to develop explicit scoring directions and establish reliability on a sample of the data. Each of these four scales yielded reliability estimates by use of the Spearman-Brown prophecy formula in the range of .86 to .91, except that .59 occurred on the first scale. Investigation of the sample data suggested that this occurred not because of disagreement between raters, but rather because the scores were generally high. With 60% of all sample scores at the maximum value, it is no surprise that the scale did not reliably discriminate between students.

Analysis and Conclusions

The mean score on computation of students in the sample was fairly high for the general population at roughly 80%. However, approximately 20% of the students attained scores below 70%, which could be considered unacceptable for pre-service teachers. Although slightly fewer students had unacceptable arithmetic concept scores, the results were quite similar. Because the correlation of the concept and computation scores was only moderate, the two tests are probably measuring sufficiently different skills that they should be retained in future analyses of this nature.

The success of over 80% of students in following the instructional manual and procedures and thereby acquiring usable data attests to the appropriateness of the materials designed for this study. The correlation data indicate that the ability to follow interviewing instructions is distinct from the ability to elicit pupils' reasoning. Also, neither are predictable from concept or computation scores.

The lowest proficiency of all evaluated interview skills was in the identification of computational strategies, thought processes and use of mathematical principles. Well over half of the students in the sample did not show acceptable ability in this skill.

This ability correlated only minimally with other tested abilities.

The composite score for the interview of course correlated

at least moderately with each of its component parts, but was best predicted from the identification score. Since this was also the most variable of the components, the result is unremarkable. The composite score was not predictable from the concept and computation scores, as its component parts had been similarly not predictable.

This failure of the concept and computation scores to correlate with the composite score or any of its parts is highly surprising. One would have anticipated that knowledge of arithmetic concepts and even proficiency in computation would have enabled the students to be more adept at eliciting and identifying reasoning processes employed by pupils. A sub-test was formed from the concept test, composed of those items which tested knowledge of addition properties which the pupils in the experiment frequently used. Even this sub-test failed to predict scores on other measures any better than the original test had done. Therefore, it appears that specific instruction is needed in both interview and interpretation techniques in order to produce teachers who can elicit and interpret pupils' reasoning underlying computation. It is recommended that such instruction be included in college methods courses.

Training procedures in the interpretation of pupil responses should be developed and tested. Such a test might compare the interview performance of a group of students before training, during training, and after training. The concept and computation scores could perhaps be obtained again and checked for prediction of gain and progress rate in developing interview skills. Also, additional studies are needed which cover a wider range of arithmetic abilities.